A Real Application of a Concept-based Electronic Medical Record

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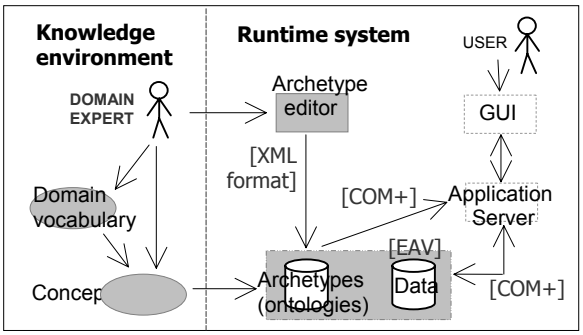
Abstract
We present a real implementation of a concept-based Electronic Medical Record for the management of heart failure disease. Our approach is based on GEHR archetypes represented in XML format for modelling clinical information. By using this technique it could be possible to build a interoperable future-proof clinical information system.

Background
Medical domain is huge and complex because of the constant evolution of the available knowledge. Moreover, information can be available from many heterogeneous resources. So medical information systems would be able to evolve over time according to the clinical knowledge development. The Electronic Medical Record (EMR) is the main component of an integrated health information environment but it could suffer from rigidity when it is built for a specific aim. We try to approach this problem in developing a EMR for heart failure patient management by using Good Electronic Health Record (GEHR) (www.gehr.org) architecture as a flexible and powerful way to model and manage clinical information. GEHR archetypes are special ontologies which enable us not only to separate information from knowledge but also to organize this in a layered structure. Moreover, we are able to constrain the creation of data to conform to a desired concept model. The GEHR approach uses a formal semantic model, known as the GEHR Object Model (GOM), to build archetypes and therefore EMRs; it defines semantic constraints between concepts and organizes them according to different levels of abstraction. This approach allow us to take all medical knowledge away from the database now storing only raw data without semantic meaning. Because we wanted to start testing this approach in a real clinical setting, we decided to use archetypes only in selected parts of a "classical" structured web-based EMR, namely to define laboratory test results.

Methods
Since we need a machine readable format for the archetypes, we chose for an XML representation. We started from the XML schema representing the constraints in the GOM and then we modified it in order to give the concepts a more flexible and powerful structure according to their clinical characteristics. As we can see in the picture below, the Web-server (Microsoft IIS) activates a COM+ object to instance relational data from data base (Microsoft SQL Server) in XML documents that transports clinical information, and vice-versa. The Web server dynamically generates the HTML pages that embed the XML data document as well as the specific XSL stylesheet needed by the browser (Microsoft IE) to display the correct layout. Laboratory test result concepts are defined in archetypes that serve as a template for the generation of the transport XML documents. This task is performed by two additional COM+ components that fill XML document with patient's data and record them in the database. Archetypes can be defined by domain expert through an archetype editor and stored in the archetype repository.



Results & Conclusions
All the laboratory exams used in the heart failure care process have been represented in archetypes and then integrated into the web-based EMR for the heart failure disease. At present, our EMR has been using and evaluating in a clinical setting for allowing central hospital clinicians, GPs and district nurses of our Province to share heart failure patient management. Now we are working at rebuilding the whole heart failure EMR using archetypes at every concept level. The advantages of an archetypes-based EMR are: 1) clinical information can be created and modified at any time without affecting the software object model or the database structure; 2) archetypes allow to define a common knowledge shared by all the actors involved in the care process; 3) access to data can be controlled at archetypes level; 4) archetypes can be a knowledge base for intelligent automated processing such as decision support system. In conclusion, using archetypes we can build an interoperable future-proof system allowing the definition and control of medical knowledge at the level of concepts.

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